The Role of Experimentation for NEO Material Models and Computational Validation of Risk Assessment and Mitigation Schemes

M. B. Boslough, M. D. Furnish, L. C. Chhabildas, D. A. Crawford, and D. E. Grady
Experimental Impact Physics Department
Sandia National Laboratories
Albuquerque, New Mexico

Experimental impact methods are used to study the dynamic states of matter in temperature, pressure, and strain-rate regimes inaccessible by other means. These techniques have been employed for many years in a wide variety of scientific, military, and commercial applications. Impact experiments make two major contributions toward ensuring the accuracy of computational simulations of dynamic high-pressure events. First, they provide the data for generating the realistic material models that are a necessary component of the shock physics codes. Second, they provide the "ground truth" by which the output of code calculations can directly be compared for validation. The range of phenomena that can be studied by impact experiments includes fracture and fragmentation, phase transitions, shock-induced melting and vaporization, impact cratering, and penetration mechanics. Material properties that can be studied include constitutive equations of state for materials, shock Hugoniots, strength, and residual microstructural effects. Because of the nature of the threat from comets and asteroids, both risk assessment and analysis of mitigation schemes will primarily be computational modeling tasks. It is crucial that the material models be physically accurate so that the analysis and prediction of impact-related and high-energy events involving comets and asteroids can be performed with a high degree of confidence. An intimate interaction between dynamic experimentation and computational analysis is required.